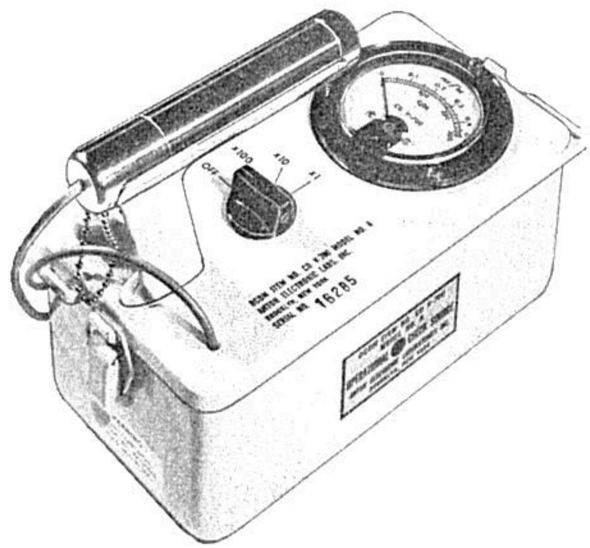
section 2

CD V-700-5&6



specifications:

- Ranges: 0-0.5, 0-5, 0-50 mr/hr
- Sensing Element: Geiger Tube
- Accuracy: ±15% of true dose rate from cobalt 60 or cesium 137 gamma radiation
- Batteries: Five 1-1/2 volt NEDA 13
- Dimensions: Model 5 - approx. 8-1/2" long x 4" wide x 6-3/4" high; Model 6 - approx. 9" long x 4-1/2" wide x 6-3/4" high - inc.handle
- Weight: approx. 4-3/4 lbs. including batteries

Anton Electronic Laboratories, Inc.

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GENERAL DESCRIPTION

Introduction

The Anton CD V-700 models 5 and 6 are portable geiger counter instruments designed for the detection of low levels of beta and gamma radiation. The geiger tube is mounted in a probe on the end of a thirty-six inch cable. The entire instrument and its accessories include a circuit box, a probe, a headphone, and a carrying strap. A radioactive sample is mounted on the side of the case for checking the operation of the instrument.

The CD V-700 models 5 and 6 vary only slightly in construction. The electrical components are the same except where noted in the parts list. The differences include a smaller meter and case on the model 5, and the addition of a detent action in the geiger probe on the model 6. For the purposes of servicing and maintenance, the units may be considered practically identical.

Sensing Indicators and Control

A meter with a scale reading in milliroentgens per hour (mR/hr) is used for visual indication and a headphone is used for aural monitoring. The meter is ruggedized and sealed in a plastic case to meet the instrument requirements for water-tightness, shock and vibration resistance.

The meter is controlled by the range selector switch labeled "OFF, X100, X10, and X1". The range switch changes only the meter ranges. It does not affect the number of "clicks" in the headphone.

Readings

Table 2-1 lists switch positions and the corresponding meter readings. Figure 2-1 shows the meter face. Readings should not be taken with the pointer indicating in the lower 10% of the scale. Turn to the next most sensitive range until the pointer indicates in the upper 90% of the scale.

Switch Position	Counts/Minute	mR/hr
X1	0-300	0-0.5
X10	0-3000	0-5.0
X100	0-30,000	0-50

Table 2-1. Switch Positions vs Meter Readings

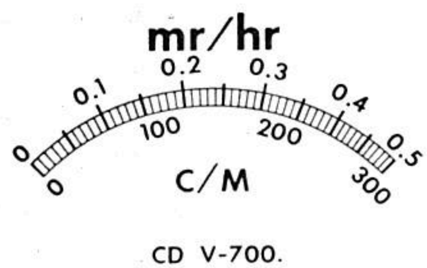


Figure 2-1. Meter Face

Initial Check

With the batteries installed, turn the range switch to the X10 position. Close the beta window of the probe. After thirty seconds the circuit should be stabilized and the meter should read zero in the absence of radiation.

Open the beta window on the probe and place the open window on the center

of the OPERATIONAL CHECK SOURCE on the side of the instrument. The meter reading should average between 1.5 and 2.5 mR/hr.

Background Count

Normal background radioactivity is about 0.01 to 0.02 mR/hr or about 20 counts per minute. Counts are randomly spaced and several seconds may elapse before any activity registers on either the meter or the headphone. Accurate measurements of background and other low level radiation can be made by counting the headphone "clicks" against a watch that has a second hand. Note the number of counts occurring in a time period of 5 minutes. Divide the number of counts by 5 and the background count is expressed in terms of counts per minute. More accurate measurements may be made by extending the time period.

Batteries

The CD V-700-5 and 6 are powered by five 1-1/2 volt "D" size flashlight batteries. The batteries will operate the instruments continuously for over 100 hours and much longer on an intermittent basis. Refer to Appendix A for acceptable types and makes of batteries.

Installation (see figure 2-2)

1. Open the case by opening the pull catch at each end of the instrument and separating the two halves. This exposes the battery holder and retaining clamps.
2. Loosen the knurled battery clamp nuts and remove the clamp and nut assembly.
3. Insert the batteries negative end first against the springs and then slide the positive terminals into the grooves to make contact with the small + contacts. The batteries will make contact only when inserted properly.
4. Replace and tighten the battery clamp and nut assemblies with the springs holding the middle battery. If the clamps are installed wrong, the case cannot be closed.
5. Close the case by aligning the two halves and closing the pull catches.

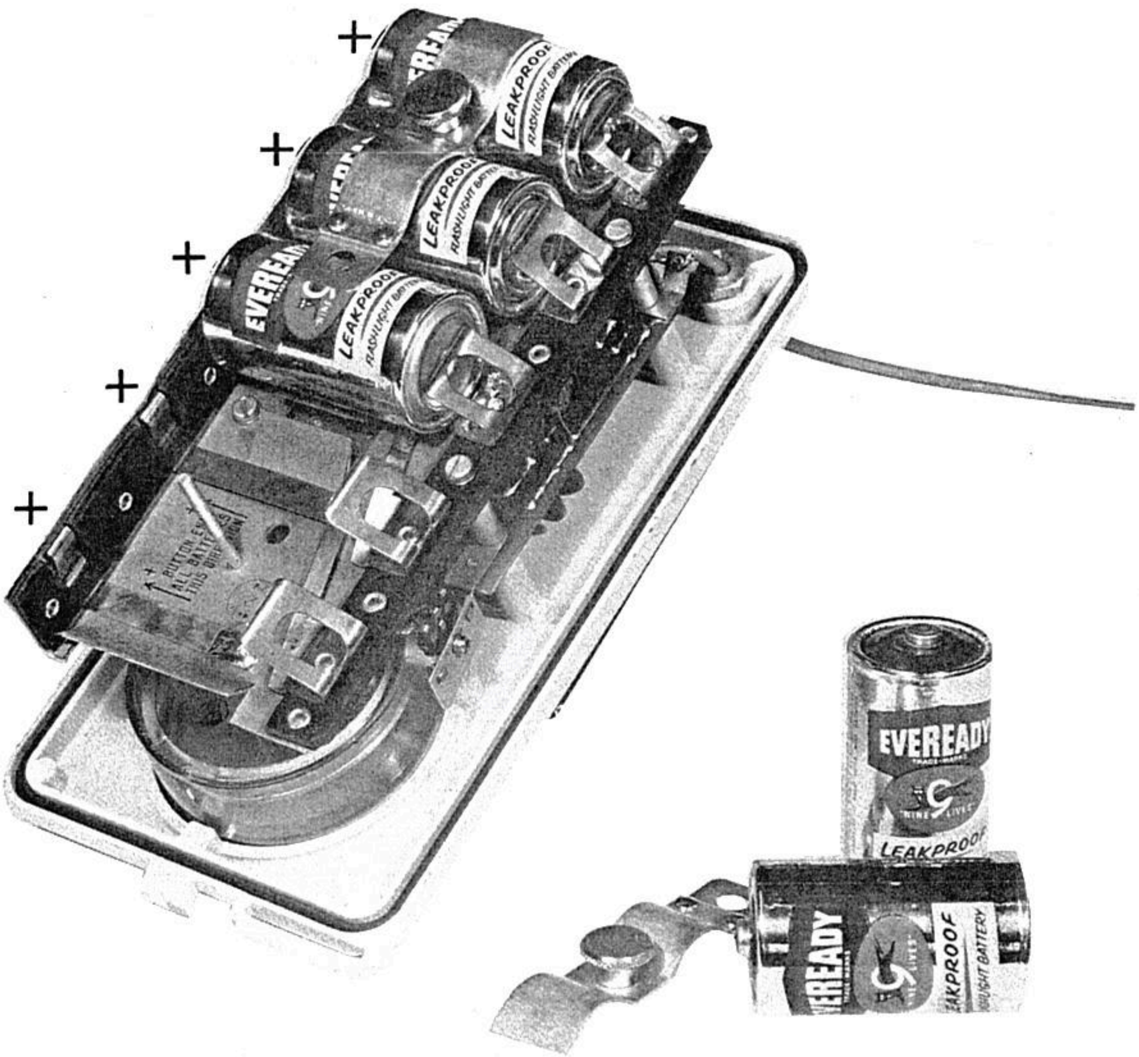


Figure 2-2. Battery Installation

Replacement

When the instrument fails to operate, check the batteries first with a battery tester. Weak or questionable batteries should be replaced. It is also advisable to replace all the batteries at one time when one battery indicates exhaustion to insure that the other batteries will not be left installed in the instrument beyond their shelf life. The batteries should always be checked prior to making further instrument repairs or adjustments.

Electronic Circuitry

High Voltage Supply

The high voltage supply consists of a blocking oscillator circuit in which pulses are generated by a transistor, V4, alternately cut-off and saturated. The transformer windings between the base and collector are so phased that when the collector current starts to flow, the voltage at the base goes in the negative direction. As the base becomes negative, the collector current increases still further causing the base to become more negative. The collector current increases until the transistor saturates, at which point the collector cannot supply the current demanded by the signal at the base. At this point, since there is no rate of change of current in the transformer, there is no signal induced in the base winding. Therefore, the emitter current decreases, decreasing the collector current. The signal then induced at the base of the transistor is such as to make this action cumulative until the transistor cuts off. The collector current stops abruptly, causing a large rate of change of current in the transformer. This makes the base go negative, which in turn starts the collector current flowing and the cycle repeats.

The step-up turns ratio between the collector winding and the secondary winding produces a high voltage pulse, which is then rectified by the selenium rectifier, CR2.

The D.C. output voltage developed across capacitor C7 is regulated by the corona discharge voltage regulator tube, V5. This regulation stabilizes the voltage supply to the geiger tube for battery voltages within the normal operating range. The high voltage is regulated at approximately 930 volts ±20 volts in most units.

Pulse Shaping and Metering Circuit

The pulse shaping and metering circuit is composed of two transistors, a rectifier and a meter. Transistors V1 and V2 form an emitter coupled, monostable multivibrator. A negative pulse from the geiger tube is coupled to the base of V1, the normal cut-off transistor. This pulse causes V1 to conduct, and a positive pulse is developed on its collector. The positive pulse is coupled to the base of V2 through the timing capacitor and cuts off transistor

V2. The resulting negative pulse on the collector of V2 is coupled to the base of V1 by the resistive voltage divider consisting of R2 and R3. This condition with V1 conducting and V2 cut off will continue for a period determined by resistor R10 and the time capacitor selected by the range switch. The voltage pulse at the collector of V1 is rectified by silicon rectifier CR1 and fed to the meter, M1. The voltage pulses at the meter are integrated by capacitor C5. The average voltage indicated on the meter is proportional to the frequency of the input pulses. The pulse frequency is proportional to the radiation field intensity, and the meter can therefore be calibrated to indicate the dose rate directly in milliroentgens per hour.

Audio Circuit

Aural monitoring is achieved by a transistorized pulse amplifier and a headphone. Each pulse counted by the pulse shaping circuit develops a negative pulse at the collector of V2. This pulse is differentiated and coupled to the base of V3 through capacitor C6. Transistor V3 is connected as an emitter coupled amplifier which drives the step-up pulse transformer, T1. The secondary of the pulse transformer is connected to the headphone jack. When the headphone is connected at the jack a pulse of approximately 15 volts is developed across the headphone, resulting in a clear, audible click.

SERVICING

Precautions

High Voltage Power Supply

The high voltage supply of the instrument operates in excess of 900 volts. The shock is uncomfortable rather than dangerous but should be avoided. The high voltage components should not be touched even when the instrument is turned off until the high voltage capacitor has been discharged. This capacitor is to be discharged by shorting the voltage regulator tube. Do not short the geiger tube leads since this causes component failure in some models.

Geiger Tube

Care must be exercised not to dent the geiger tube. Dents in the tube may cause arcing at voltages lower than the operating voltages and the tube will be useless. Dropping the tube may cause leakage of the gas mixture.

Semi-Conductor Components
(Diodes and Transistors)

The diodes and transistors used in the instrument may be damaged by prolonged heating during soldering. When replacing any of these components, the soldering operation should be done quickly. Hold the lead between the compon-

ent and the joint with a heat sink to decrease the amount of heat transmitted to the component. Techniques are described in section 1 of this Manual.

Transformers

When replacing the power transformer, T2, use care not to pinch the leads under the transformer bracket on the circuit board. On some models, the pulse transformer, T1, has a metal case. The leads must be positioned so that they will not short to the case.

Disassembly Instructions

1. Remove the battery clamps and batteries if present.
2. Remove the four screws with their lockwashers and spacers from the underside of the instrument. Note that the spacers are cut down to fit a recess in the battery box. The battery box can now be moved aside for trouble shooting.
3. Remove the range switch knob by loosening the two set screws.
4. Remove the nuts holding the wires to the meter terminals and unsolder the leads to the geiger probe and the headphone. Press slightly on the range switch shaft and the circuit board should come free of the case top.
5. Reassembly is the reverse of the above steps.

Preventive Maintenance

It is recommended that preventive maintenance be carried out once a month when the instrument is in use and once every six months when the instrument is in storage as follows:

1. Remove the batteries and clean the battery box contacts and the contacts on each of the batteries to remove any corrosion present.
2. Test the batteries on a battery tester and replace any weak or questionable ones.
3. With the batteries reinstalled, turn the range switch to the most sensitive range and check for a background count.
4. If the instrument is to be shipped or stored, remove the batteries and

set the range switch to one of the sensing ranges. This will shunt the meter and minimize damage from movement of the pointer during shipment or storage.

Do not use cleaning solvents on the plastic parts. Use soap and water to clean the case. If the batteries have leaked, remove the case bottom and fill it with warm water. The battery spillage will be loosened in a short while and can be rinsed out. Dry the case carefully before reassembling.

Repairs

Replacing the Geiger Tube

1. Grasp the end caps of the probe and twist in a counterclockwise direction to unscrew the tube housing from the socket housing.
2. Insert the new geiger tube into the socket pressing the tube into the socket and against the rubber gasket. Do not handle the thin beta window.
3. Place the tube housing over the geiger tube.
4. Engage the threads of the tube housing and socket housing with a steady pressure against the shock mounting spring and screw together in a clockwise direction. Overtightening may interfere with the operation of the beta shield.

Replacing the Voltage Regulator Tube

The VR tube is held to the circuit board with a standard fuse clip. To remove the tube, unsolder the leads and press on the top of the tube to lift the leads. The new tube should be installed with the cathode connected to ground and the anode (red dot) connected to point M. (See figure 2-4) Position the leads so that no strain is exerted on the metal-to-glass seals. Figure 2-3 shows a properly installed VR tube.



Figure 2-3. VR Tube Placement

Replacing the Geiger Probe

1. Remove the battery compartment and unsolder the probe leads from the circuit board.
2. Remove the seal nut with an adjustable wrench.
3. Pull the cable through the hole in the case top.
4. Prepare the new cable according to instructions in section 1 of this Manual.
5. Twist the center conductor and shield together to allow the wire to be inserted through the case top. Pull on the end of the cable with pliers until a sufficient amount extends through the case top.
6. Replace the seal nut and washers on the new cable and tighten the seal nut using moderate pressure. Excessive tightening can damage the cable.
7. Connect the cable to the circuit board and replace the battery compartment.

Replacing the Switch

The range switch is held to the circuit board with a nut and lockwasher and may be removed in a conventional manner. Remove the nut and lockwasher and unsolder as many leads as necessary to remove the switch. Installation is the reverse of this procedure.

Trouble Shooting

The information in this section is presented as an aid to the service technician in determining the causes of specific instrument faults. The Trouble Shooting Guide lists the most probable causes of instrument failure together with suggestions for corrective action. This should be consulted and followed after the following preliminary steps have been taken:

1. Disassemble the instrument through step 2 of the Disassembly Instructions.
2. Check all batteries. Make sure they provide sufficient voltage for proper operation of the instrument.
3. Check the printed circuit board for broken foil, cold solder joints, or solder bridges.

4. Check for broken components.

Table 2-2, Test Point Chart, and figure 2-4, Location of Test Points and Components, eliminate the need for circuit tracing when making voltage and resistance measurements. The Test Points are referred to in the NOTES column of the Trouble Shooting Guide, and are also found on the schematic circuit diagram.

TROUBLE SHOOTING GUIDE

SYMPTOM		PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
Meter	Headphone			
Dead	Dead	Poor connection to batteries	Repair connection	
		Geiger tube defective or not compatible with instrument's high voltage	Replace geiger tube or correct instrument's high voltage	Check starting voltage of tube. This must be lower than voltage at point M
		Probe shield shorting to high voltage power supply	Dress leads	Voltage at M=0 V1 may be damaged
		Geiger probe defective	Repair or replace geiger probe	Check V1 for damage after repairing probe
		CR2 defective	Replace CR2	Voltage at M low ≈ 1075 V
		V4 defective	Replace V4	Check voltages at G, J, M. Check V4 for beta and shorts. Check T2 before replacing V4

SYMPTOM		PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
Meter	Headphone			
Dead (cont'd)	Dead (cont'd)	V1 defective	Replace V1	Check V1 for beta and shorts. Check probe and C1 for shorts before replacing V1
		V2 defective	Replace V2	Check V2 for shorts
		T2 defective	Repair or replace T2	Check resistances at H - ▲ G - J K - L
		C1 open	Replace C1	Voltages normal. Check by tapping with screwdriver at probe pin 1 and at point P
		C1 shorted	Replace C1	Voltage at M low V1 may be damaged
		C7 open	Replace C7	Voltage at M low
		C7 shorted	Replace C7	Voltage at M=0, others normal
		C8 open	Replace C8	Voltage at M low
		C8 shorted	Replace C8	Voltage at J, M low
		Open contact on S1B	Repair contact	

		Open contact on S1C	Repair contact	
Dead (X100 only)	Dead	C2 open	Replace C2	
		Open contact on S1A	Repair contact	Check continuity at **S** - T
Dead (X10 only)	Dead	C3 open	Replace C3	
		Open contact on S1A	Repair contact	Check continuity at Q - T
Dead (X1 only)	Dead	C4 open	Replace C4	
		Open contact on S1A	Repair contact	Check continuity at N - T
Dead	Normal	Meter defective	Repair or replace meter	
		Calibration control turned fully counterclockwise	Recalibrate	
		CR1 open	Replace CR1	
		C5 shorted	Replace C5	
Dead	Weak	V2 defected	Replace V2	
Normal	Dead or Weak	Poor connection in headphone or plug jack	Repair connection	
		Headphone defective	Repair or replace headphone	
		V3 defective	Replace V3	Check V3 for beta and shorts

SYMPTOM		PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
Meter	Headphone			
Normal (cont'd)	Dead or Weak (cont'd)	T1 defective	Replace T1	Check resistance at D - ▲ F - ▲
		C6 defective	Replace C6	
Upscale	Dead	V1 defective	Replace V1	Check voltages at P, R, and T. Check V1 for shorts
		V2 defective	Replace V2	Check V2 for beta and shorts
Upscale (X100 only)	Dead	C2 shorted	Replace C2	
Upscale (X10 only)	Dead	C3 shorted	Replace C3	
Upscale (X1 only)	Dead	C4 shorted	Replace C4	
Upscale	Squeal or Buzz	C7 open	Replace C7	Check voltage at M. Symptoms may cease when voltmeter is connected
		C8 open	Replace C8	Voltage at M low
		T2 defective	Replace T2	

SYMPTOM		PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
Meter	Headphone			
High or Low (cont'd)	Normal (cont'd)	V1 or V2 beta high or low	Replace with transistor having proper gain	
		V5 defective	Replace V5	Check voltage at M
		C5 defective	Replace C5	
		C7 defective	Replace C7	

Reads w/no Detection

Upscale	Hiss or Click	Probe shield shorting to high voltage supply	Dress leads	V5 Voltage at M low or intermittent. V1 may be damaged
		Geiger probe defective	Repair or replace geiger probe	Voltage at M low or intermittent. V1 may be damaged
		Geiger tube defective	Replace geiger tube	
		V5 defective or not making contact to circuit board	Replace or resolder V5	Voltage at M high
		T2 defective	Repair or replace T2	Voltage at M low or intermittent
Erratic	Normal	C5 open or unpolarized	Replace C5 polarize	Ground Anode
		Meter defective	Repair or replace meter	
High or Low	Normal	R6 not adjusted properly	Recalibrate	
		Geiger tube defective or not compatible with instrument's high voltage	Replace geiger tube or correct instrument's high voltage	
		Meter defective	Replace meter	
		CR1 defective	Replace CR1	
		CR2 defective	Replace CR2	Voltage at M low

RESISTANCE CHART

Remove batteries before checking resistances. All values ±20%.

<table>
<tr><th>Component</th><th>Points</th><th>Range Switch Position</th><th colspan="2">Resistance (ohms)</th></tr>
<tr><td>S1A</td><td>T - S
T - Q
T - N</td><td>X100
X10
X1</td><td colspan="2">0
0
0</td></tr>
<tr><td>S1B</td><td>A - ▲</td><td>All except OFF</td><td colspan="2">0</td></tr>
<tr><td>S1C</td><td>E - ▲</td><td>All except OFF</td><td colspan="2">0</td></tr>
<tr><td>T1</td><td>D - ▲
F - ▲</td><td>Any
Any</td><td>6
65</td><td>1
30</td></tr>
<tr><td>T2</td><td>K - L
G - J
H - ▲</td><td>Any
Any
Any</td><td colspan="2">5
8
5500</td></tr>
</table>

VOLTAGE CHART

Voltages negative with respect to point ▲. Use a 20,000 ohms per volt meter. All values ±20%.

Point	Voltage	Voltmeter Range
M	-920	*
C	4.5	10
T	4.5	10
G	3.0	10
J	2.7	3.0
B	0.6	3.0
R	0.5	3.0
P	0.4	3.0

*Use a high impedance voltmeter. See Appendix B.

Table 2-2. Test Point Chart

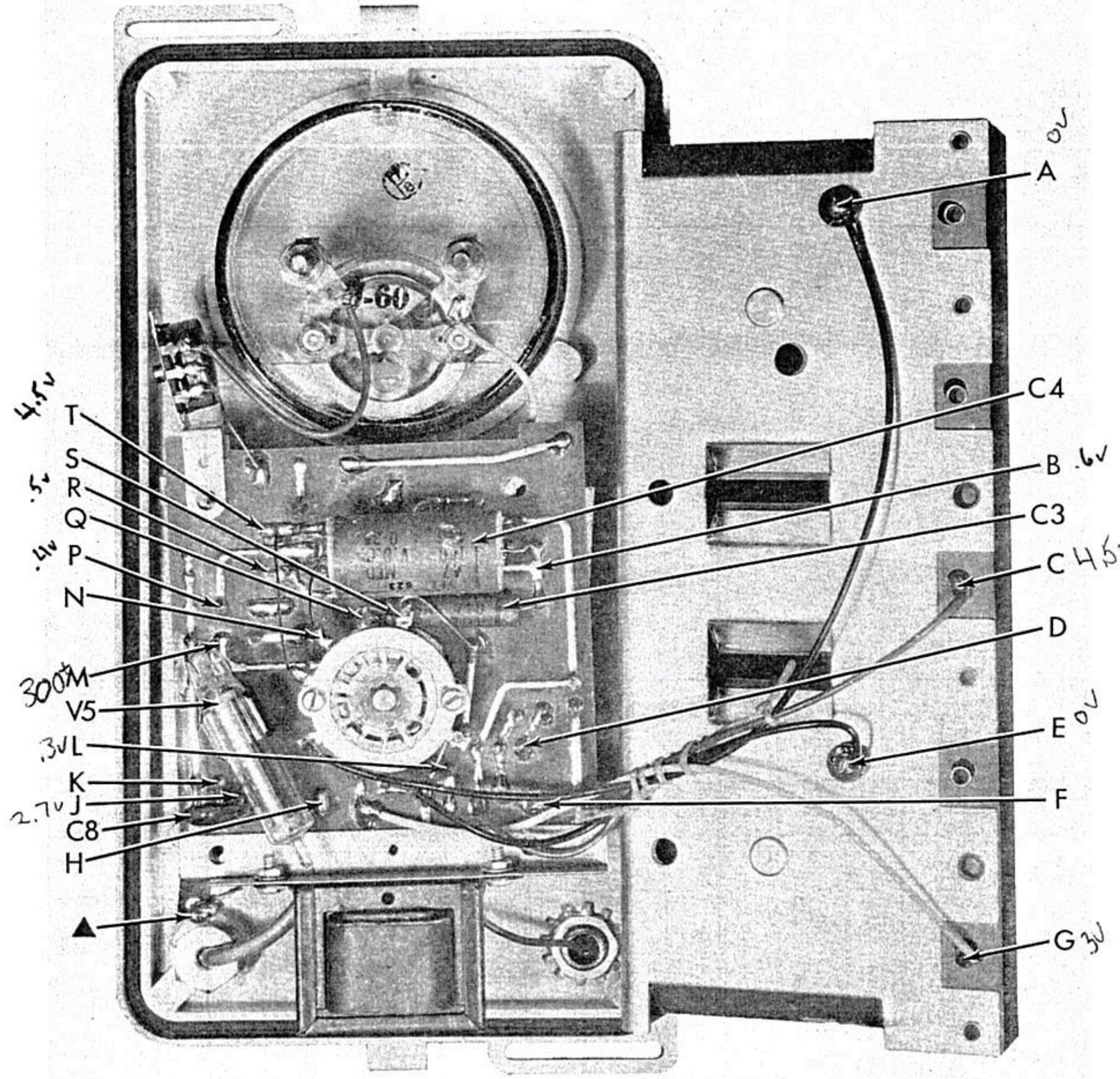


Figure 2-4. Location of Test Points and Components

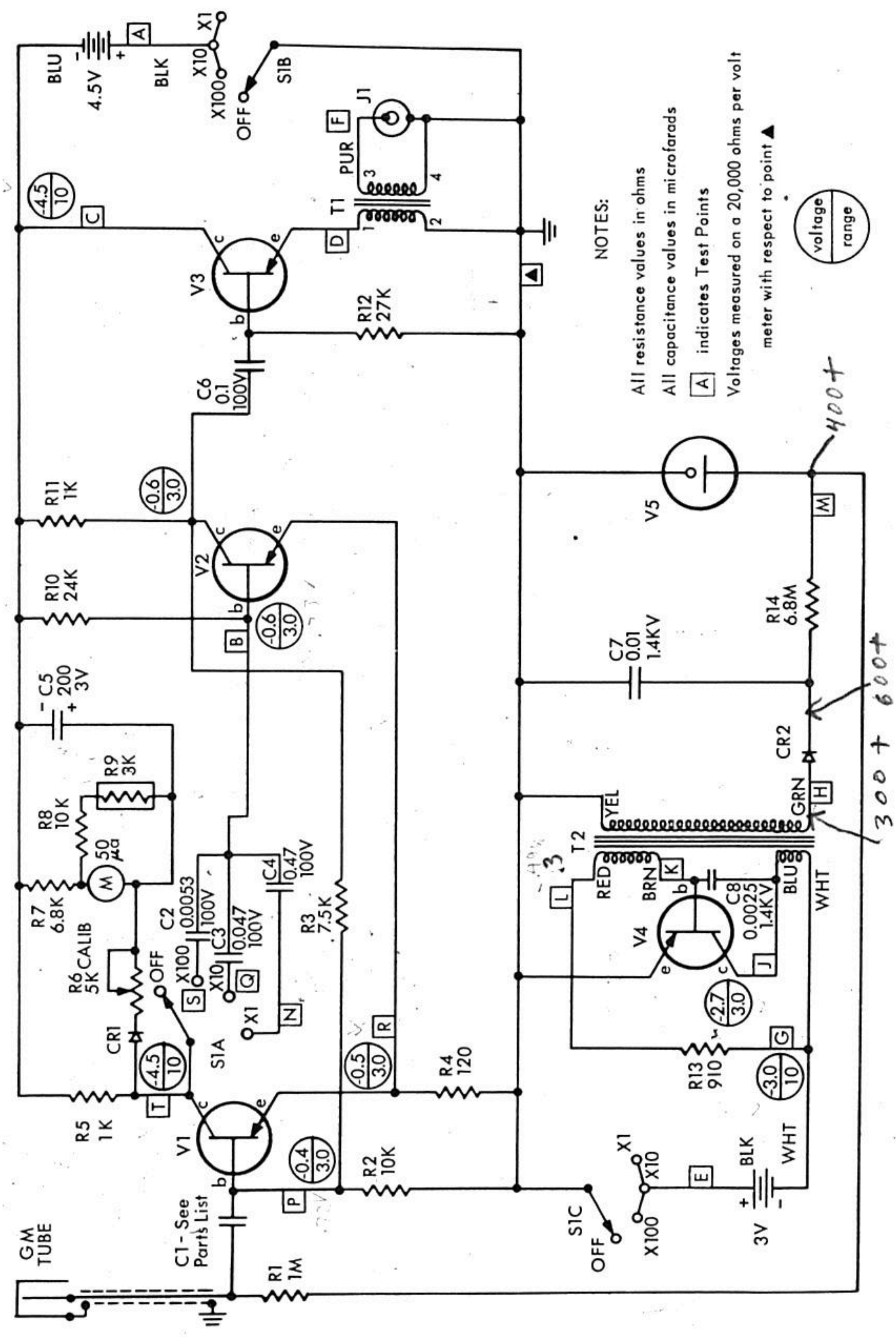


Figure 2-5. Schematic Circuit Diagram

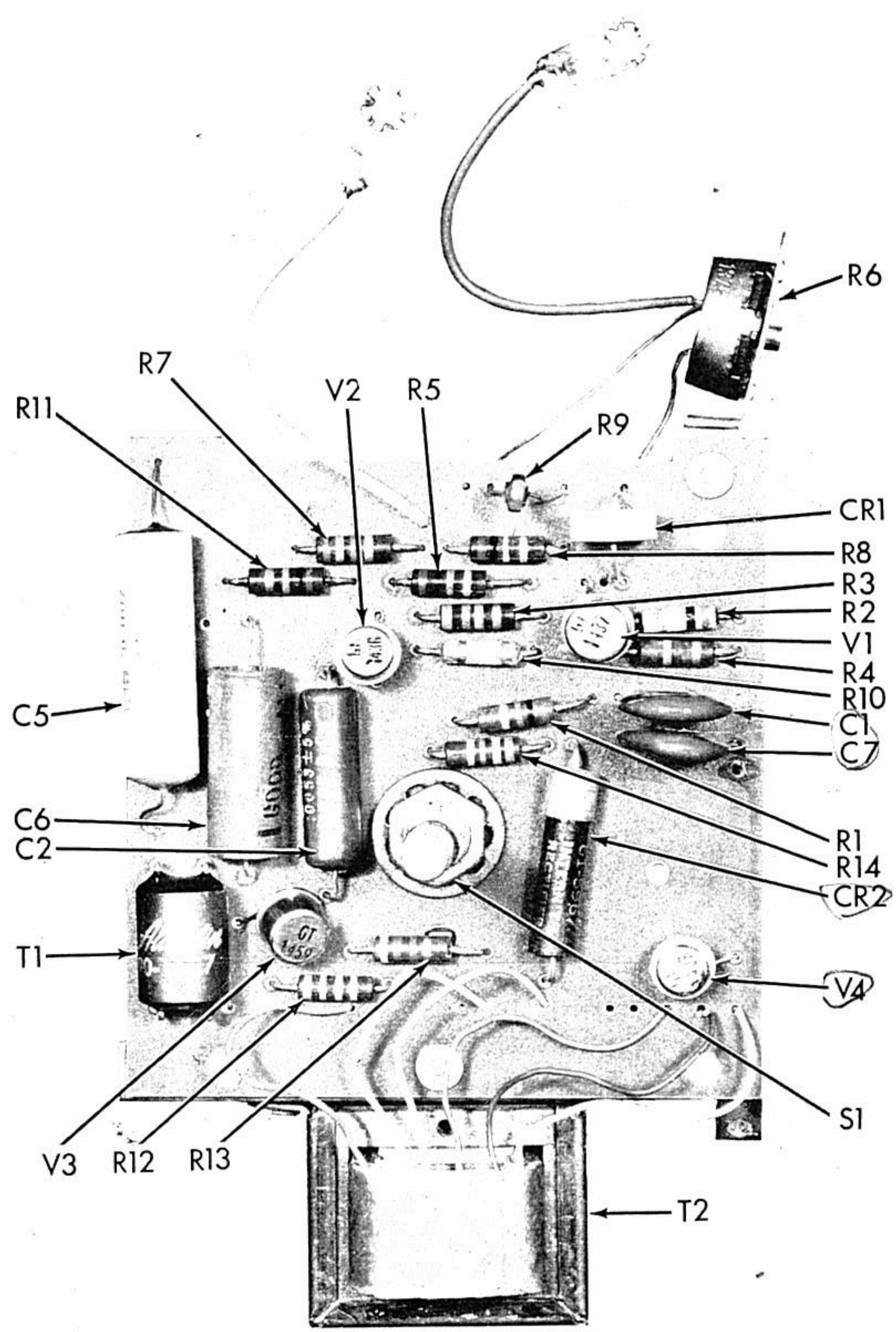


Figure 2-6. Location of Components

PARTS LIST

Electrical Components

Circuit Symbol	Description	Function	Manufacturer & Part No.	Anton 700-5 Part No.	Anton 700-6 Part No.
B1, B2, B3, B4, B5	Battery "D" size 1-1/2V NEDA 13	Supply power	National Carbon 950	106-198	106-198
C1	Capacitor (model 5): 0.0025 ufd (model 6): 0.001 ufd +100% -20% 1.4KV	Blocks H.V. and couples signal to V1	Good-All Electric Mfg. Co. Type B	106-177	——
C2	Capacitor 0.0053 ufd ±5% 100V	Timing X100 range	Good-All Electric Mfg. Co. Type 600VE	106-178	106-178
C3	Capacitor 0.047 ufd ±5% 100V	Timing X10 range	Good-All Electric Mfg. Co. Type 623	106-179	106-179
C4	Capacitor 0.47 ufd ±5% 100V	Timing X1 range	Good-All Electric Mfg. Co. Type 623	106-180	106-180
C5	Capacitor 200 ufd 3V	Integrating	Continental Components Corp. EAH 7330	106-181	106-181
C6	Capacitor 0.1 ufd +40% -0 100V	Coupling to audio amplifier	Good-All Electric Mfg. Co. Type 623	106-182	106-182

Circuit Symbol	Description	Function	Manufacturer & Part No.	Anton 700 - 5 Part No.	Anton 700-6 Part No.
C7	Capacitor 0.01 ufd +100% -20% 1.4KV	H.V. filter	Good-All Electric Mfg. Co. Type G	106-183	106-183
C8	Capacitor 0.0025 ufd +100% -20% 1.4KV	Stabilizes H.V. power supply	Good-All Electric Mfg.Co. Type B	106-177	106-177
CR1	Rectifier	Meter rectifier	Anton Electronic Labs.Inc. 106-28	106-28	106-28
CR2	Rectifier	High voltage rectifier	International Rectifier Corp. 61-5967	106-29	106-29 21066
GM	Geiger tube	Sensing element	Anton Electronic Labs.Inc. 6993	6993	6993
H	Headphone 4K ohms at 1kc	Aural indicator	Anton Electronic Labs.Inc. 106-176	106-176	106-176
J1	Phone jack	Headphone connector	Anton Electronic Labs.Inc. 106-131	106-131	106-131
M	Meter 0-50 ua	Indicates radiation intensity	Anton Electronic Labs.Inc. 106-101	106-101	106-101
R1	Resistor 1 megohm 1/2W 10%	VR tube load, geiger tube load	International Resistance Co. BTS	106-184	106-184
R2	Resistor 10K ohm 1/2W 5%	V1 bias network	International Resistance Co. BTS	106-185	106-185

Circuit Symbol	Description	Function	Manufacturer & Part No.	Anton 700-5 Part No.	Anton 700-6 Part No.
R3	Resistor 7.5K ohm 1/2W 5%	V1 bias network	International Resistance Co. BTS	106-186	106-186
R4	Resistor 120 ohm 1/2W 5%	Multivibrator emitter resistor	International Resistance Co. BTS	106-187	106-187
R5	Resistor 1K ohm 1/2W 10%	V1 collector load	International Resistance Co. BTS	106-188	106-188
R6	Potentiometer 5K ohm 1/4W	Calibration adjust	Chicago Telephone Supply Co. (Type PE-70) (HR 4052)	106-189	106-189
R7	Resistor 6.8K ohm 1/2W 10%	Time constant	International Resistance Co. BTS	106-190	106-190
R8	Resistor 10K ohm 1/2W 10%	Temperature compensation	International Resistance Co. BTS	106-191	106-191
R9	Thermistor 3K ohm ±10%	Temperature compensation	Victory Engineering 33D2	106-192	106-192
R10	Resistor 24K ohm 1/2W 5%	Multivibrator Timing	International Resistance Co. BTS	106-193	106-193
R11	Resistor 1K ohm 1/2W 5%	V2 collector load	International Resistance Co. BTS	106-194	106-194
R12	Resistor 27K ohm 1/2W 10%	V3 base return	International Resistance Co. BTS	106-195	106-195

Circuit Symbol	Description	Function	Manufacturer & Part No.	Anton 700-5 Part No.	Anton 700-6 Part No.
R13	Resistor 910 ohm 1/2W 5%	V4 base bias	International Resistance Co. BTS	106-196	106-196
R14	Resistor 6.8 megohm 1/2W 10%	VR tube load	International Resistance Co. BTS	106-174	106-174
T1	Transformer	Audio step-up	Anton Electronic Labs.Inc. 106-102	106-102	106-102
T2	Transformer	Blocking oscillator and high voltage step-up	Anton Electronic Labs.Inc. 106-121	106-121	106-121 21076
V1	Transistor	Multivibrator	General Transistor Corp. 1437	106-199	106-199
V2	Transistor	Multivibrator	General Transistor Corp. 1436	106-200	106-200
V3	Transistor	Audio pulse amplifier	General Transistor Corp. 1459	106-201	106-201
V4	Transistor	High voltage power supply	General Transistor Corp. 1438	106-202	106-202
V5	Voltage regulator tube	Voltage regulation	Anton Electronic Labs.Inc. 106-197	106-197	106-197

Mechanical Components

Description	Function	Manufacturer & Part No.	Anton 700-5 Part No.	Anton 700-6 Part No.
Battery clamp (2)	Battery retainer	Anton Electronic Labs.Inc. 106-114	106-114	106-114
Battery holder assembly	Holds batteries	Anton Electronic Labs.Inc. 106-104	106-104	106-104
Cap and chain assembly	Covers phone jack	Anton Electronic Labs.Inc. 106-115	106-115	106-115
Case bottom	Bottom of instrument	Anton Electronic Labs.Inc.	106-116	114-105
Gland	Water seal; holds probe cable	Anton Electronic Labs.Inc. 106-106	106-106	106-106
Handle assembly	Holds probe	Anton Electronic Labs.Inc. 106-108	106-108	106-108
Handle gasket	Water seal	Anton Electronic Labs.Inc. 106-109	106-109	106-109
Jack gasket	Water seal	Anton Electronic Labs.Inc. 106-110	106-110	106-110
Knob	Range switch knob	Anton Electronic Labs.Inc.	106-175	114-175
Meter gasket	Water seal	Anton Electronic Labs.Inc.	106-103	114-104
Name plate	Contains operational check source	Anton Electronic Labs.Inc.	106-113	114-113

Description	Function	Manufacturer & Part No.	Anton 700-5 Part No.	Anton 700-6 Part No.
Panel	Top cover	Anton Electronic Labs.Inc.	106-119	114-103
Panel gasket	Water seal	Anton Electronic Labs.Inc.	106-107	114-106
Printed circuit board	Supports components	Anton Electronic Labs.Inc.	106-117	106-117
Probe-cable assembly	Geiger tube case	Anton Electronic Labs.Inc.	106-158	114-158
Strap assembly	Carrying strap	Anton Electronic Labs.Inc.	106-124	106-124